MANTECH Publications
Journal of Research in Mechanical Engineering and Applied Mechanics
Volume 9, Issue 1, January-April, 2024

Ecopedal Power: Green Energy Generation through Treadmill Cycles

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Abstract

This project deals with the design and fabrication of the treadmill cycle. The treadmills are not used to harness power, but as exercise machines for running or walking in one place, we are utilizing same principle for travelling a shorter distances. The motion of the machine is achieved by transferring the human's energy to the machine through the concept of treadmill. This machine can be helpful for travelling to short distances as well as used for exercise to the peoples. Using this machine, allotting a separate time for their exercise is not needed. The same action performed on the treadmill is used in this machine for the movement of the machine. When the operator, walks On the treadmill then the machine moves forward.The Walking Bicycle is a new way of moving. It is a fun and Eco- Friendly way of transport in affordable price. The idea behind this bicycle is how we can use treadmill outside the Gym. We aspired to build the walking bicycle that is faster than walking and easier to ride than a conventional bicycle. In this Walking bicycle the frame of the bicycle is completely modified ie. The cycling pedals are replaced with a treadmill. When you are walking on the treadmill, you push the treadmill backward with your feet and you move forward

Keywords: *Ecopedal, Treadmill cycles, Green power generation, Harnessing energy, Sustainable fitness*

INTRODUCTION

A Treadmill is a device generally for walking or running while staying in the same place. Treadmills were introduced before the development of powered machines, to harness the power of animals or humans to do work, often a type of mill that was operated by a person or animal treading steps of a tread wheel to grind grain. In later times, treadmills were used as punishment devices for people sentenced to hard labour in prisons. The terms treadmill and tread wheel were used interchangeably for the power and punishment mechanisms.

More recently, treadmills are not used to harness power, but as exercise machines for running or walking in one place. Rather than the user powering the mill, the machine provides a moving platform with a wide conveyor belt driven by an electric motor or a flywheel. The belt moves to the rear, requiring the user to walk or run at a speed matching that of the belt. The rate at which the belt moves is the rate of walking or running.

The simpler, lighter, and less expensive versions passively resist the motion, moving only when walkers push the belt with their feet. The latter are known as manual treadmills. The conveyor belt is coupled to the wheels of the treadmill cycle by a suitable arrangement so that when the user walks, the machine is moved forward and vice versa.

WORKING PRINCIPLE

A treadmill cycle operates on the fundamental principle of converting human mechanical energy into kinetic energy, simulating the experience of outdoor cycling within an indoor environment. As the user pedals, rotational motion is transmitted through a system of gears and pulleys, driving the rotation of the treadmill belt. This motion creates resistance, providing a challenging workout that targets various muscle groups.

The adjustable resistance levels allow users to tailor their workout intensity to their fitness level and goals. Additionally, the incorporation of digital displays enables users to monitor their performance metrics, such as speed, distance, and calories burned, enhancing their overall exercise experience.

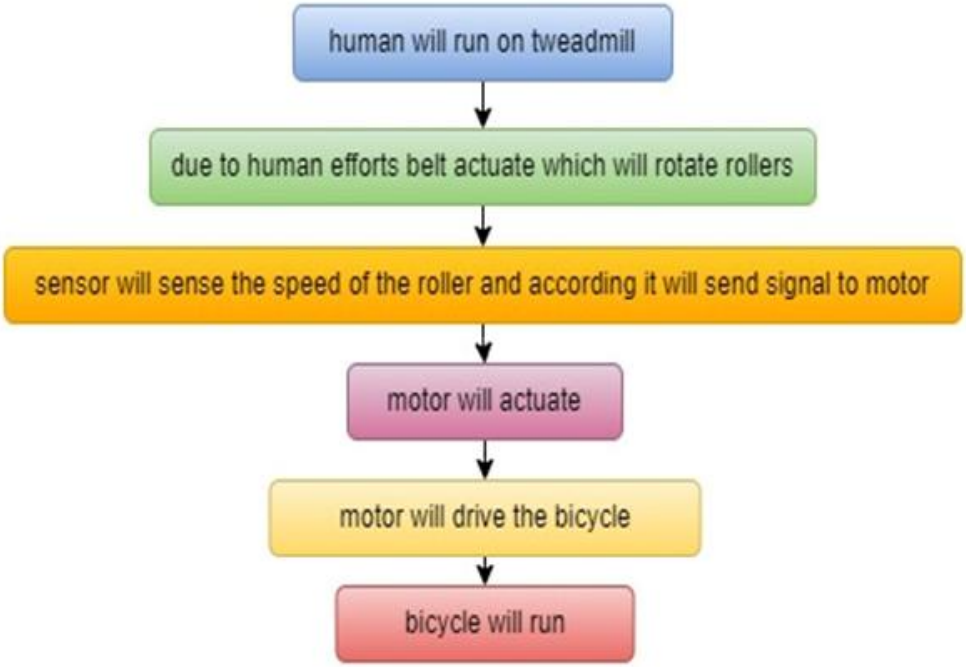

Fig.1 A Schematic Diagram of Working Principle of treadmill cycle

The fabrication of the treadmill traveler is very advantageous because of its simple construction and easy working principle. To say in a one line, this machine follows the action of the user. That is, when the driver walks forward, the machine moves forward and when he walks backward, the machine moves backward. A treadmill setup is made so that the operator can walk on the belt. A handle is placed in the front for the controlling of the vehicle. The rollers above which the conveyor belt (treadmill belt), held in tension are coupled to the wheels of the machine, usually rear wheels. The rollers are connected by a suitable arrangement for efficient transmission of motion thus having minimal losses during the transmission of motion. The frame of the machine is designed in such a way that it is balanced and the operator doesn't put any effort in balancing the machine. Now when the operator walks forward, the conveyor belt moves in one direction which makes the wheels of the machine to rotate so that the machine moves front. When he walks backwards, the motion direction of the belt is reversed and thus the vehicle moves forward.

METHODOLOGY

The research outlined in this thesis aims to address the challenges identified in the preceding discussion points. To achieve this objective, specific goals have been established. Firstly, the research will focus on identifying and comprehensively understanding the problem at hand.

This involves a thorough examination of existing literature and relevant studies to gain insights into the issues surrounding treadmill cycle design and functionality. Subsequently, material selection for the various components of the treadmill cycle will be conducted, taking into account factors such as durability, strength, and cost-effectiveness. Following this, the design of individual parts will be developed, alongside the selection of appropriate bearings to ensure smooth operation and longevity. The fabrication process will then be executed, incorporating key activities such as metal cutting, sawing, welding, and drilling, with careful consideration of process parameters to achieve optimal results. Additionally, the determination of shaft length and diameter, as well as the analysis of forces acting on both moving and stationary components, will be integral to the design and performance of the treadmill cycle. The assembly of the unit will follow, ensuring precise alignment and functionality of all parts. Finally, the project will be finalized, encompassing rigorous testing and validation procedures to ensure compliance with predetermined specifications and user requirements. Through this comprehensive methodology, the research endeavors to provide innovative solutions and advancements in the field of treadmill cycle design and fabrication.

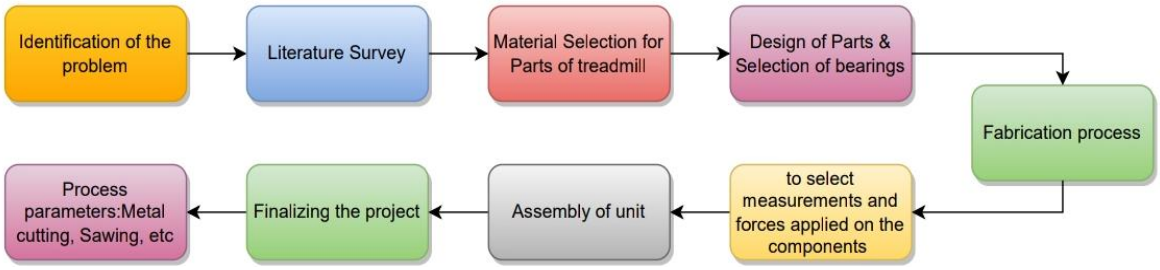

Fig.3 Step by step Procedure of Fabrication of Fig. Principle diagram of treadmill cycle

COMPONENTS

In the construction of a treadmill cycle, several essential components are meticulously integrated to ensure optimal performance and user experience. The wheels serve as the foundation, providing stability and mobility to the cycle. The treadmill belt, stretched across the frame, facilitates the smooth rotation necessary for walking or running exercises. Supporting the movement of the belt, rollers play a crucial role in reducing friction and ensuring consistent operation. The integration of a hub motor, powered by a battery, enables automated adjustments in speed and incline, enhancing the versatility of the cycle. A sprocket and chain mechanism transfers power from the motor to the belt, efficiently driving the treadmill. Additionally, a solar panel may be incorporated to harness renewable energy,

supplementing the battery's power supply. Precision bearings with bearing caps ensure smooth rotation and minimize wear and tear, prolonging the lifespan of critical components. The inclusion of a spur gear system further optimizes power transmission, enhancing the efficiency of the cycle. Lastly, connecting wires facilitate communication between electronic components, enabling seamless operation and control. Through the integration of these components, the treadmill cycle offers a robust and reliable platform for cardiovascular exercise and fitness training.

Table.1 : Various components used for fabrication of treadmill cycle

S.No.	PARTS	Qty.	Material
1	Frame	1	M.S
2	Wheels	2	Rubber
3	Treadmill Belt	1	Rubber
4	Roller	2	M.S
5	Hub motor	1	-
6	Battery	1	Lead acid
7	Sprocket	2	Steel
8	Chain	1	Steel
9	Solar panel	1	Silicon
10	Bearing with bearing cap	6	M.S
11	Spur gear	2	C.I
12	Connecting wires	-	Copper

DESIGN, STANDARD SIZES AND CALCULATIONS:

The design of a treadmill cycle involves careful consideration of various factors to ensure optimal performance, safety, and user comfort. Standard sizes for key components such as the frame, treadmill belt, and motor are typically determined based on industry norms and ergonomic principles. Calculations play a vital role in determining these sizes, taking into account factors such as user weight, intended usage, and desired performance metrics. For example, the frame should be sturdy enough to support the weight of the user and withstand the forces generated during exercise. The treadmill belt's dimensions are calculated based on the user's stride length and width requirements for comfortable walking or running. The motor size and power rating are determined based on the desired speed range and incline

capabilities of the treadmill. Additionally, calculations are performed to determine the optimal gear ratio for efficient power transmission from the motor to the treadmill belt. Standard sizes and calculations are crucial in ensuring that the treadmill cycle meets industry standards, performs reliably, and provides an enjoyable exercise experience for users of all fitness levels.

a.Machine shafts

Up to 25 mm steps of 0.5 mm

b. Transmission shafts

25 mm to 60 mm with 5 mm steps
60 mm to 110 mm with 10 mm steps
110 mm to 140 mm with 15 mm steps
140 mm to 500 mm with 20 mm steps
The standard lengths of the shafts are 5 m, 6 m and 7m.

Harnessing power from a treadmill cycle involves converting the mechanical energy generated by the user's movement into electrical energy. The power generated can be calculated using the following formula:

Torque = Force Radius of wheel

Human force required for sliding rollers = 225 N

Radius of cycle wheel ro = 325mm, ri = 265mm

Torque = Force Radius of wheel = 225 325 =73125 N – mm

Without considering the rolling resistance and air drag

Average velocity of bicycle = 15.5 km/hour

Velocity = angular velocity Radius of wheel = 4.30556 = Speed N = 127 rpm

Power required to drive a cycle ,P = 972.076 Nm/s = 0.972 Kw

c. Calculation for Belt:

Design power = Rated power(P) Service factor(KS) Arc of contact factor(Ka)

Rated power (P) = 0.972 KW

Service factor (KS) = 1.2 [Steady load] PSG 7.53

Arc of contact = 1800 – 600

Diameter of belt roller (D) = 40 mm

Diameter of belt roller (d) = 40 mm

Center distance (C) = 1000 mm

Arc of contact = 1800 – (0) = 1800

Correction factor (Ka) = 1.00 [PSG 7.54]

Design power = 0.972 1.2 1.00 = 1.1664 KW

d. Dunlop FORT 949g fabric belt is selected

Belt speed (V) = 0.2659 m/s

No of ply 5 is selected

Belt load rating = Load rating at 10 m/s

Load rating at 10 m/s = 7.6845 Kw/mm/ply

Width of belt = 303.5 mm

Standard width of Dunlop FORT 949 g is 305 mm PSG 7.52

Length of belt (L) = 2C + (D+d) + = 2 + (80) + (0) = 2125.66 mm

Initial tension to be provided = 0.5% of Length of belt [PSG 7.53] = 10.62 mm

Length after standard deduction for initial tension = 2125.66 – 10.62 = 2115.04 mm

Roller width for 305 mm width belt = 305 + 38 = 343 mm

Therefore the Belt length and width are calculated, design is safe.

FABRICATION OPERATIONS

The fabrication process of a treadmill cycle involves a series of operations aimed at crafting a durable and functional exercise machine. This intricate process encompasses various techniques and skills, each contributing to the quality and efficiency of the final product. Among the key operations employed are arc welding, brazing, turning, drilling, and finishing. These processes are meticulously executed to ensure structural integrity, precise alignment, and a polished aesthetic appearance.

By seamlessly integrating these operations, manufacturers can produce high-quality treadmill cycles that meet the demands of fitness enthusiasts worldwide. In this discussion, we will delve into each operation, elucidating its significance and role in the fabrication process, thereby providing insight into the meticulous craftsmanship behind the creation of these exercise machines.

Fig.4 Final Fabricated Threadmill Cycle

FUTURE SCOPE

Solar powered treadmill bicycle is modification of existing walking bicycle. As we all know a manual treadmill does not consume any electricity, thus using treadmill and some arrangements of gears and chain drive, we make a treadmill bicycle. With a less effort this bicycle can be drive as well as a new format of the bicycle design can be launched in the market for exercise with cleaning. As the user walk on the treadmill the belt moves to the rear side and rotates rollers of treadmill which gives the starting torque. Gear assembly is connected with roller shaft by which whole assembly get sufficient torque and moves treadmill ahead. Brake system is provided for speed control. Treadmill walking platform is slightly inclined for better torque. This inclination is done by different diameter of front wheel and rear wheel or framing arrangement.

It can be used as an indoor locomotive device infrastructure with large roof span i.e. malls, warehouse, open markets, large office spaces, etc.

- By using such product pedestrian cops can save themselves from getting exhausted.
- Pedestrians in large campuses can benefits from this product the same way.
- Can replace cycle as an energy efficient vehicle for those who cannot drive a cycle.
- In this we have made a shear modification of treadmill and cycle running through solar assisted energy, which is a non-conventional and renewable energy.
- It is completely eco-friendly and emission free with no running cost and less maintenance
- This cycle can be an adaptable mode of transportation for rural and urban areas.

In the ever-evolving realm of fitness and gym culture, the concept of ecopedals has emerged as a groundbreaking solution, catering to both health enthusiasts and eco-conscious

individuals alike. Imagine a scenario where those interested in evening walks not only contribute to their personal well-being but also actively participate in harnessing energy for sustainable purposes. The innovative ecopedal technology extends its reach beyond traditional fitness equipment, finding applications in automobiles, specifically in two-wheeler and light vehicle sectors. This revolutionary approach transforms routine exercises into a dual-purpose activity, promoting physical fitness while simultaneously generating green power. As the fitness industry embraces this environmentally friendly trend, ecopedals mark a significant stride towards a healthier lifestyle and a greener future for our planet.

CONCLUSION

In conclusion, the treadmill cycle stands as a testament to innovation and engineering prowess in the realm of fitness equipment. Through the integration of advanced technologies, meticulous design considerations, and precise manufacturing processes, the treadmill cycle offers users a versatile and effective platform for achieving their fitness goals. Its ability to simulate outdoor cycling experiences within the confines of an indoor environment caters to the diverse needs and preferences of fitness enthusiasts worldwide. The comprehensive design, incorporating standard sizes and precise calculations, ensures optimal performance, safety, and user comfort. As we look towards the future, continued research and development in treadmill cycle technology promise further advancements, enhancing functionality, connectivity, and user experience. Ultimately, the treadmill cycle remains a cornerstone in promoting health and well-being, empowering individuals to lead active and fulfilling lifestyles.

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